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Ontario Ministry of Natural Resources
Southcentral Sciences Section
Technical Note #04

By

Tim Haxton

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Introduction

Bullfrogs (*Rana catesbeiana*) have traditionally been captured by hand or dipnet from a canoe, and/or from shore with the use of hipwaders, (Durham and Bennett 1963, Scott and Woodward 1994, Shirose et al. 1993, Shirose and Brooks 1997, Hecnar and M'Closkey 1997). These methods are intensive and time consuming, and usually have mixed results, dependent upon timing of sampling and weather conditions (Scott and Woodward 1994, Shirose and Brooks 1997).

Nocturnal sampling during the breeding period usually targets chorusing males and subsequently results in a biased ratio of mature males to females and juveniles (Haxton unpubl. Data, Shirose et al. 1993, Shirose and Brooks 1997). Diurnal sampling can be effective and reduce sex bias, however can also be influenced by weather conditions (Haxton unpublished data; Shirose and Brooks 1997). Bullfrogs have been noted to be less visible when the temperatures were greater than 30°C, and were found to be more skittish and quicker when temperature and humidity increase (Haxton unpublished data).

The monitoring of bullfrogs using conventional methods has been conducted in several plots established within Pembroke District (Haxton 1997). In attempts to sample bullfrogs more efficiently, a method of rapid sampling using an airboat was explored on two of these plots. This report summarizes the results of this method.

Study Area

Permanent sampling plots were established in two marshes in Pembroke District (Figure 1). Muskrat River/Mud Lake (Figure 2) is a 783 hectare, provincially significant wetland located in Stafford Township of Renfrew County. The marsh component where sampling was concentrated covers an area of 140.6 hectares, is less than 2 metres deep, and is characterized by floating and submergent vegetation with an abundance of wild rice (*Zizania palustris*). Wilber Lake (Figure 3) is a 287.8 hectare lake located in Wilberforce Township with a maximum depth of 2.3 metres and a mean depth of 0.9 metres, and has been evaluated to be a provincially significant wetland. Submergent and floating vegetation comprise the vegetation community along the shore of Wilber Lake.

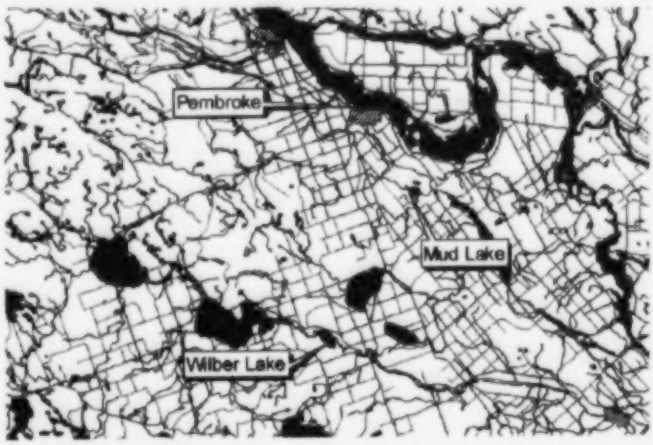

Figure 1. Location of Mud Lake/Muskrat River and Wilber Lake.

Methods

An initial effort was made with the airboat on Muskrat River/Mud Lake in 1997, with more intensive sampling on both Muskrat River/Mud Lake and Wilber Lake in 1998.

The airboat required a crew of three, including an experienced driver and two crew members at the front to capture bullfrogs with dipnets. Sampling was conducted exclusively at night. The airboat was equipped with halogen lights and the driver was equipped with a one million candle-light spotlight beam for navigation and to help in locating bullfrogs. Once captured, bullfrogs were placed in 60 cm x 90 cm, closed containers located at the front of the airboat.

Figure 2. Muskrat River/Mud Lake in Stafford Township.

Figure 3. Wilber Lake in Wilberforce Township

Sampling was conducted in a systematic manner, with the airboat working specific sections of the marsh. Once an area was thoroughly sampled, the airboat would transfer the bullfrogs to a sampling boat located in an accessible area of the marsh. This boat was also on site in case of an emergency with the airboat.

Bullfrogs were processed while the airboat worked another section of the marsh. Snout-vent length (SVL) and weight were measured for each bullfrog, and sex was determined using secondary sexual characteristics (e.g. tympanum larger than diameter of eye in mature males, about the same size as the eye in females; swollen thumbs and yellow throats on mature males (Bury and Whelan 1984)). All bullfrogs were toe-clipped for mark-recapture purposes and genetic analysis[1]. The portion of toe to be removed was prepared by applying EMLA cream (lidocaine 2.5%, prilocaine 2.5%) for 10 seconds and was clipped at the first joint of the mid-digit using sterilized scissors. Furacin solution (0.2%) was applied to the wound. The sampled bullfrogs were then returned, by the airboat, to the general area where they were originally captured while the next batch of bullfrogs were processed.

1 Being conducted by James Austin, Masters graduate student, Queen's University.

Sampling was conducted on two consecutive nights in each location in an attempt to establish a population estimate through mark-recapture techniques. Bullfrog population estimates were calculated for Wilber Lake and Muskrat River/Mud Lake using the Petersen estimate (Donnelly and Guyer 1994). The 95% confidence intervals (C.I.) for the population estimate were determined by ± 2 standard error (Davis and Winstead 1980). Bullfrog density was calculated by dividing the population estimate by the area of the marsh.

Results

Airboat sampling was conducted on Muskrat River/Mud Lake on August 17, 1997, July 14 and July 15 in 1998, and August 3 and August 4 in 1999. Airboat sampling was conducted on Wilber Lake on July 20 and 21, 1998 and August 9, 1999.

The training and capture time at Muskrat River/Mud Lake in 1997 was approximately three hours. Additional time was required to sample and process the bullfrogs. A total of 266 bullfrogs were sampled at Muskrat River/Mud Lake in 1997 (Table 1). In 1998, a total of 675 bullfrogs were sampled over the two nights (296 on July 14 and 379 new bullfrogs on

Table 1. Attributes of bullfrogs sampled using an airboat at two sites in Pembroke District.

Muskrat R./Mud L 1997	**Male**	**Female**	**Juvenile**
# of captures	127	124	15
average SVL (cm)	12.4 ± 0.96	12.2 ± 1.44	8.4 ± 0.64
average weight (grams)	303	295	172
Muskrat R./Mud L 1998			
# of captures	385	261	29
average SVL (cm)	12.8 ± 0.86	12.5 ± 1.32	7.9 ± 1.0
average weight (grams)	190	178	51
Muskrat R./Mud L 1999			
# of captures	220	242	43
average SVL (cm)	13.4 ± 1.13	13.1 ± 1.33	6.1 ± 1.4
average weight (grams)	215	206	52
Wilber Lake 1998			
# of captures	76	96	32
average SVL (cm)	12.7 ± 1.11	12.5 ± 1.63	8.0 ± 0.93
average weight (grams)	179	175	47.5

July 15), with 46 recaptures (sampled and marked the previous night; Table1). The population estimate for bullfrogs in Muskrat Lake in 1998 was 2,735 ± 762 (95% C.I.), resulting in an average of 19.5 bullfrogs per hectare. In 1999, a total of 506 bullfrogs were sampled over the two nights (304 on August 3 and 202 new bullfrogs on August 4), with 37 recaptures (Table 1). The population estimate for bullfrogs in Muskrat Lake in 1999 was 1,964 ± 584 (95% C.I.), resulting in an average of 14.0 bullfrogs per hectare. The male to female sex ratio was 1:1 in 1997, 1.5:1 in 1998 and 0.91:1 in 1999 (Table 3).

A total of 206 bullfrogs were sampled at Wilber Lake in 1998 over the two nights (114 on July 20 and 98 on July 21), with six recaptures on the second night (Table 1). The bullfrog population on Wilber Lake was estimated to be 1,862 ± 1,473 (95% C.I.), giving an average of 6.5 bullfrogs per hectare. The sex ratio was 0.8:1 (Table 3). Two of the bullfrogs

Table 3. Comparison of the efficiency of airboat versus conventional techniques for sampling bullfrogs.

Survey method	Year	Effort (hrs)	Number of Captures	Sex Ratio (male:female)	Capture Rate (bullfrogs/hr)
Conventional	1996a	33	649	1.3:1	19.7
Conventional	1996b	21.25	157	1.7:1	7.4
Conventional	1997a	15.25	125	6.7:1	8.2
Conventional	1997b	5.25	40	1.2:1	7.6
Airboat	1997a	3*	266	1.1:1	88.7
Airboat	1998a	13	675	1.5:1	51.9
Airboat	1999a	9	506	0.91:1	56.2
Airboat	1998b	6	206	.08:1	34.3

a - Muskrat River/Mud Lake
b - Wilber Lake
* - not including processing time

Table 2. Attributes of bullfrogs sampled by conventional methods at two sites in Pembroke District.

Muskrat R./Mud L 1996	Male	Female	Juvenile
# of captures	103	83	313
average SVL (cm)	11.7	11.7	7.3
average weight (grams)	176	174	64
Muskrat R./Mud L 1997			
# of captures	100	15	10
average SVL (cm)	10.4	10.0	7.4
average weight (grams)	159	139	66
Wilber Lake 1996			
# of captures	58	35	2
average SVL (cm)	13.4	13.1	8.4
average weight (grams)	267	237	80.9
Wilber Lake 1997			
# of captures	14	12	14
average SVL (cm)	13.1	11.7	6.6
average weight (grams)	260	194	41

sampled were metamorphs (i.e. frogs undergoing transformation), with an average SVL of 4.9 cm. Sampling was conducted only partially one night in 1999 as the weather conditions turned cold (air temperature <9.4°C) and bullfrogs were primarily submerged (38 bullfrogs sampled in 2 hours).

Size by sex data for bullfrogs captured by conventional methods at these same two sites are presented in Table 2 for comparison. The sex ratio varied from 1.2:1 to 6.7:1 at the Muskrat River/Mud Lake site (1996 and 1997, respectively) and from 1.2:1 to 1.7:1 at Wilber Lake (1997 and 1996, respectively). Comparative data on capture rates and sex ratios between conventional and airboat techniques are presented in Table 3.

Discussion

The airboat technique was more efficient in capturing bullfrogs than conventional techniques. In 1997, the only year when direct comparisons of techniques and sites can be made within the same year, the capture rate of the airboat technique was approximately 10 times the capture rate by conventional methods.

Sampling efficiency diminished with the onset of cold weather and could be applicable to both conventional and airboat techniques. Bullfrogs are most active at higher temperatures, however, have been documented to be active in air temperatures as low as 10°C (Bury and Whelan 1984). For the greatest efficiency, sampling should be conducted when air temperatures are 15°C and greater.

Sampling was conducted in mid-August in 1997 to avoid the breeding season and thereby disrupting the territorial behaviour of male bullfrogs (Howard 1979; Ryan 1980; Wells 1977). During the breeding season, females are usually secretive and remain well away from chorusing males until they are ready to mate (Howard 1979; Ryan 1980; Bury and Whelan 1984). The nearly equal sex ratio on Mud River/Muskrat Lake suggests that both sexes were distributed throughout the marsh at that time of the year. Sampling was conducted a month earlier in 1998 and that may account for the preponderance of males in the sample from Muskrat River/Mud Lake that year. The extremely high bias in favour of males resulting from sampling by conventional means (6.7:1 on Muskrat River/Mud Lake in 1997) may be a result of either timing of sampling or limited sampling area within the marsh, or both.

It was noted that several species of birds (e.g. moor hens, marsh wrens) were still nesting when sampling was being conducted in mid-July of 1998, and it is possible that some nests may have been disrupted while searching for bullfrogs. Therefore, airboat sampling of bullfrogs should be conducted after the end of July, once marsh birds have finished nesting.

Sampling was conducted on consecutive nights in 1998 and 1999 in an attempt to use mark-recapture ratios to derive a population estimate. Since very few recaptures were sampled the second night, an addition night of sampling may be required to obtain a reasonable population estimate.

Very few juveniles were sampled using the airboat. This may have been the result of bias by personnel on the airboat, selecting the largest, most visible bullfrogs. However, it also may have resulted from cannibalism since all bullfrogs captured were placed in the same container on the airboat, regardless of size. Since juveniles are less readily visible

and therefore less catchable, in 1998 it was decided to concentrate sampling on adult bullfrogs and sample fewer juveniles.

Wilber Lake has several cottages and camping resorts situated along the shoreline, and several complaints were received about the noise of the airboat and disturbance from the lights, specifically after midnight. Residents and cottage owners in the vicinity of marshes chosen for sampling should be informed prior to sampling to minimize disturbance and complaints.

The airboat is used annually for banding ducks during the period from mid-August until mid-September. Using the airboat for sampling bullfrogs from late July to mid-August not only provides a new, more efficient sampling technique for monitoring bullfrogs, but also offers an alternative use for equipment that would otherwise remain dormant.

In conclusion, the airboat proved to be both an effective and efficient tool for sampling populations of bullfrogs in marshes. This has tremendous potential for establishing baseline data on bullfrog populations and for monitoring population trends in the future. The use of the airboat as a tool to aid in the sustainable management of this resource should be investigated.

Recommendations

1. Continued sampling of bullfrogs by this method is recommended because of the demonstrated efficiency of the technique, and by diversifying its uses, it enhances the value of the airboat as a resource management tool.
2. The potential for widespread use of the airboat sampling to monitoring trends in bullfrog populations requires further investigation.
3. Further investigation of the mark-recapture method of population estimation is recommended as a possible means for determining baseline population data.
4. Sampling from the airboat should be conducted in late July to mid-August to reduce potentially negative impacts on nesting marsh birds and waterfowl.
5. Sampling should be conducted when air temperatures are 15°C and greater.
6. Use of the airboat for sampling bullfrogs on any marsh or waterbody should be preceded by proper public notification and, whenever necessary, consultation with local residents and cottages to ensure co-operation and to minimise complaints.
7. Sort bullfrogs by size at time of capture to reduce cannibalism.

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